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The Inheritance of Acquired Characters and its Bearing on Eugenic Theory and Practice.

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The phrase "acquired character" is one to which a variety of meanings may be attached and it is therefore desirable to get as clear a conception as possible of the meaning to be attached to it when it is used in connection with heredity.

A certain school have tried to maintain that the whole dispute as to whether acquired characters are inherited on not is mere empty logomachy; since they maintain that all characters are acquired by the organism in its reaction with the environment, and yet, that the capacity so to react is innate in the organism and part of the hereditary complex which it has received from its ancestors.

Now there is a certain measure of truth in this contention. Organisms do not come into the world fully formed as Minerva is said to have sprung complete in all her armour from the head of Jove. They are separated from the parent as minute comparatively formless germs and they "acquire" all the peculiar marks of the adult during their subsequent growth. For this growth they require a peculiar environment—and if this environment is lacking, growth and differentiation are either suspended altogether or are checked and diverted into monstrous paths. The hereditary complex remaining the same, the form of the body of the animal is conceived of as the resultant of the impact of the environment on this complex, and when the environment varies it need not surprise us that the resultant effect of this impact, viz., the form of the animal's body, is different.

This sounds extremely plausible reasoning; but as so often happens a broad generalisation covers real differences and obscures the points at issue in the dispute. The word "environment" includes the action of a vast number of different agents diverse not only in magnitude but in kind. The vestigial eye of the Cave-newt Proteus, in its normal environment of darkness, retrogrades instructure as it grows until the eye is reduced to a mere mass of pigment cells, but if it be exposed to light of the right degree of intensity it develops into a large functional eye with well developed lens and a retina differentiated into the normal types of ganglion cells and sense-cells. On the other hand the eye of the the embryo-rabbit in the darkness of its mother's womb will develop lens and retina quite as far as does the eye of Proteus when exposed to

the light. In the first case we are dealing with the environment under the form of a functional stimulus, which we may broadly characterise as "use"—in the second the environment supplies only warmth, oxygen and food, without which no animal life can be carried on. Such stimuli might be called nutritional stimuli. The questions at issue then concern the inheritability of the effects of functional stimuli. The points raised are these (1) Does or does not the overgrowth of an organ in response to the stimulus of a use greater than normal so react on the whole organisation that the germ cells of the animal will give rise to offspring which will react to the same environment by producing an overgrowth of the same organ more rapidly and to a greater degree than did their parents—in a word is there a "carry-over"—of the effects of use? and (2) does the disuse of an organ so affect the body that its germ cells give rise to offspring, which when exposed to the same environment will give rise to corresponding organs of diminished size? It seems to me that these are clear and definite questions to which it should be possible to give unequivocal answers, and to find the right answers to these questions has been called by Herbert Spencer the most transcendently important of biological questions—for on the answer which we give depends our conception of the *modus operandi* of evolution, and of much of the value of education. Since the time of Weismann the majority of biologists have followed him in denying the action of the environment on the germ-cells. Since the hereditary complex must have been altered if evolution occurred (a hypothesis which all accept), these alterations are described as 'chance' mutations which stand in no causal relation to the environment whatever.

Now the final ascription of the these all important mutations which constitute the material of evolution to "chance" is really a despairing confession of ignorance—a position with which no true scientific man can remain content.

But the consensus of opinion in favour of Weismann, reinforced though it has been by the discoveries of Mendel and of the Mendelian school of biologists, has never been absolute. As our knowledge of Palaeontology has increased and successions in the stratified rocks have come to light which at any rate closely resemble evolutionary series geologists have been impressed with the resemblances which these series of fossils show to the increase of size with increase in function which may be observed in the bodies of living animals during their lives. The study of the life histories of animals forces home on us the conviction that the different phases of their existence are correlated with different habits, and that metamorphosis which implies the passage from one set of habits to another, originated in the history of the race as a migration of the ancestral stock from one environment to another in search of food, and the changed adult structure was the result of that migration—and did not occur by "chance" independently of it.

Five years ago in this journal I gave an account of some experiments carried out by Kammerer in the Institute for Experimental Zoology in Vienna. These experiments consisted in rearing the spotted salamander from the time it metamorphoses until the time when it attains sexual maturity, in cages with different coloured backgrounds.

The specimens so treated acquired different colours of skin and these colours, Kammerer maintained, were in some degree transmitted to the posterity of these animals when they bred. These experiments if confirmed would prove the possibility of the inheritance of acquired characters, but much scepticism has been expressed of Kammerer's good faith in the matter. As the salamander requires four years to reach sexual maturity, it is obvious that to test the validity of Kammerer's results by repeating his experiments would require at least eight years, and none of Kammerer's critics are willing to give the time to do this; they content themselves with attempting to find proofs of Kammerer's infidelity by criticising his figures.

I wish now to bring forward some further evidence of the inheritability of acquired characters from some other experiments of Kammerer and from some very recent experiments by Guyer, which I am now about to describe. Bateson, the leading English Mendelian says that if Kammerer's experiments were confirmed, they would go a long way towards proving his point, viz., that modification produced by the environment in the adult can be handed on to the young. These experiments deal with the reproduction of the midwife toad, Alytes obstetricans. In order to understand the peculiar habits of this species it is necessary to say a few words about the reproduction of frogs and toads in general. As all are aware these animals begin their existence as tadpoles which live in water and have many of the characteristics of fish. At an early stage in their development they possess an enlarged head followed by a constricted neck which then widens into a plump body which terminates in a blade-like vertically flattened tail. On the hinder aspect of the head there are situated on each side four gillslits, the walls of which are at first adherent to one another, so that the slits are "virtual" not patent. From the upper margins of the first three slits there arise feather-like outgrowths, the so-called external gills. As the tadpoles grow older a fold of skin grows out from the side of the head on each side and covering over the indentation caused by the neck becomes united to the broad plump trunk behind. The external gills are thus shut inside a gill chamber, the gillslits become patent and the larva assumes the well-known appearance of the tadpole with rounded body and flat tail.

Since the tadpole as soon as it emerges from the egg requires water to live in, the adults repair to the water in spring in order to mate and to deposit the eggs. The male mounts on the back of the female and claps her with his arms round the waist. There he remains in a state of wild sexual excitement for several weeks, croaking loudly until she is ready to lay her eggs. These in the toad are emitted in two long strings one from each oviduct, and at the moment of emission the male fertilizes them by depositing spermatozoa on them. The strings of eggs consist of a double or triple row of the small black eggs held together by a gelatinous material secreted by the oviduct which swells when it touches water.

Since the skin of the female when wetted becomes soft and slippery it is difficult for the male to retain a secure hold of her. In order to aid him in this task, he develops on the index finger of the hand and on the palm below it a horny patch of skin which is raised into small asperities.

Now the mid-wife toad differs from other toads in the fact that he mates not in the water but on land in a cool, damp spot. Under these conditions the skin of the female is rough and warty, like that of other toads under similar circumstances, and consequently the male does not need the horny patch which we have described and does not develop it. The female produces very many fewer eggs than the ordinary toad (about 60 instead of 800), but these eggs are of larger size and contain much more food yolk than those of ordinary toads. When they are emitted the male after fertilizing them winds one string round each leg, and thus encumbered hops away. His normal life on land is interrupted by frequent visits to the water to bathe, a habit in which all toads indulge. When the larvae are ready to hatch out, they emerge from the eggs on the occasion of their father's next visit to the water, but their free-life begins at a much later stage of development than that of other toads. When they first appear they have already covered up their gills and have attained the characteristic appearance of the late tadpoles of other toads. If however we open one of the eggs some time before it is tready to hatch we can discover in it the toad embryo which is provided with *one external gill only* on each side.

Now Kammerer tried the experiment of keeping Alytes under warm dry conditions, and he found that they could be acclimatised to such conditions and flourished fairly well under them, provided the enclosure in which they were kept was provided with a tank of water in which they could bathe themselves at will. As the temperature was raised they repaired oftener to the water to cool themselves, and they began to mate in water. Under these circumstances the skin of the female and the egg strings both became slippery and the strings slipped off in spite of the male's endeavours to wind them round his legs. The eggs fell to the bottom of the water and the great majority perished. If however special efforts were made to keep the water sterile some few eggs would survive and with great care could be reared through the tadpole to the adult stage.

In warm climates, like those of Vienna, Alytes normally mates twice in the year (April and September), and becomes sexually ripe at the age of one year. As an individual can be kept alive for at least three or four years, it follows that a female may have seven or eight breeding periods in her life. When exposed from the beginning to the warmer conditions which have just been described, the males at first attempt to carry out their normal functions of caring for the eggs, but as successive breeding periods come on they gradually desist from this entirely and then the eggs fall directly from the female to the bottom of the water. If now larvae are reared from these eggs, it is to be noticed that they escape at a much earlier period of development than do the normal tadpoles of Alytes, at a period in fact corresponding to that at which the tadpoles of other toads are hatched. The eggs from which these early tadpoles arise are smaller than the normal eggs and have less yolk and are produced by the female in greater numbers (90-115). These abnormal tadpoles possess on either side *one long external gill* of very delicate texture; this gill, adapted primarily to life inside the egg membrane has to shrink and become provided with a thicker skin before it is suited to water breathing.

If now these abnormal tadpoles be reared to maturity, those which arise from eggs produced by the mother *after she has been long accustomed to hot conditions*, will give rise to adults, which go at once to the water to pair and which lay eggs from which arise tadpoles *with three external gills on each side* like those of other toads. When the breeding was carried a generation further males were produced which showed wart-like thickenings on the first fingers and on the palm of the hand which they needed in order to maintain their hold on their slippery partners when pairing in the water. As such warts had never before been described in the case of Alytes, Bateson seized on this as a test case for estimating the trustworthiness of Kammerer's results. During a visit to Austria he saw Kammerer and asked to be shown these males with horny pads. This request Kammerer was unable or unwilling to gratify and Bateson concluded that the whole story was false and that all Kammerer's work might be dismissed as non-evidential. In this unsatisfactory state matters remained during the great war, but three months after the armistice had been signed a further paper by Kammerer was published in which he gave the results of further breeding experiments on Alytes. In his first paper he had carried the experiment far enough to produce the F3 generation, but in his second paper he described the results of a culture which extended to the F6 generation. In these later generations the horny pad becomes accentuated: it is noteworthy that the place where it is formed varies—it sometimes is placed as high up as the wrist. Kammerer explains his inability to satisfy Bateson on several grounds, viz., (1) that the horny patch is a temporary phenomenon since it is composed of cornfield epidermal cells which are shed as soon as the breeding season is over, and that when Bateson was there none of his Alytes were pairing; (2) that he had always to consider whether to kill his abnormal males and preserve them in order to exhibit them to sceptical outsiders or to keep them alive in order to continue the race and that he had decided on the latter course. He mentions incidentally that in earlier years he had sent his large eyed Proteus for the inspection of other naturalists and that he had never received them back again. A year later Kammerer followed up this paper by sending to Bateson, whom he recognised as his principal opponent, sections through the skin of the normal Alytes male and also through the skin of the abnormal male showing the pad. These sections which Bateson was kind enough to show to the writer of this paper, bear out completely the figures which Kammerer published in his second paper and the only way in which his conclusions can be evaded is to suppose that these sections were not taken through the skin of Alytes at all—in other words to suppose Kammerer guilty of deliberate and premeditated fraud—a step which even Bateson declines to take.*

Those however who do not impute fraud to Kammerer seek to deny the evolutionary significance of his discoveries on the ground that as

*Since writing this account a paper by Przibram the head of the Institute of Experimental Zoology has appeared in which, while reserving his opinion as to Kammerer's conclusions, he maintains in the strongest manner the *bonafides* and trustworthiness of Kammerer's observations which were made under his supervision.

Alytes is merely a modified toad and as the other toads (cf. Bufo Pelobates, &c) produced tadpoles with three external gills on each side and males with the horny pad, the ancestors of Alytes must have possessed these powers and that consequently all that Kammerer has done has been to recall to activity a disused power. This is no doubt true; but just therein lies its evolutionary importance. Certain people seem to have a confused idea that evolution consists in the appearance of something new and unprecedented. Even Darwin had visions of organs like eyes arising from functionless rudiments. Now in our opinion all this conception is a profound mistake. More complex organs can be traced back step by step to simpler organs and these in the last resort to the great fundamental organs of skin, stomach-wall and body-cavity lining. Greater elaboration with greater use and degeneration with lessening use have been the great factors in evolution. Alytes has been differentiated from other toads by pairing on land, and by the retention of the young within their egg membranes which has followed as a consequence, both these habits may reasonably be ascribed to a change of climate from a warm and moist to a cold and dry type: when experimentally the climate is changed to a warm one, corresponding changes take place in the habits and the original habits of the ancestors are redeveloped.

Guyer's work deals with the inheritance of imperfect eyes in Rabbits. A few introductory remarks are necessary in order to explain the principle on which he worked. Most of us have heard of the "anti-bodies" which guard our bodies against the onslaughts of disease. When disease germs obtain access to the body, they pour out dangerous poisons (toxins) into the circulation. The white cells of the blood in their efforts to combat these, learn to produce substances called anti-toxins, which not only neutralize the toxins but eventually destroy the germs which produce them. This power once acquired is retained by these white cells for a very long time which sometimes extends to years; it is for this reason that we rarely take measles twice.

But quite similar anti-bodies are produced by the blood when it is invaded by other foreign bodies of an organic nature which are not alive at all. Thus minute quantities of castor oil introduced into the circulation will evoke the formation of an anti-body which will enable the blood to digest and so get rid of any further castor oil which may be introduced.

Now Guyer took for his toxic-organic product which he injected into the veins of his experimental animal, the lenses from the eyes of Rabbits. These lenses were ground up in a mortar (pulped) in Ringer's solution (which is water containing several salts in solution mixed in the same proportions as they are found in the serum of human blood) and the solution so formed was injected into the common domestic fowl. After a period of several weeks, the blood of these injected fowls was taken and freed from its blood-cells, so that the pure serum could be used.

If small doses of this serum—which contained an antibody capable of digesting the lens—were injected into the bodies of pregnant female rabbits, the injection had no effect whatever on the eyes of the mother rabbit, but some of the young were so affected that they were

born with the lens of one or both eyes reduced in size and opaque. The vertebrate eye consists of two essential parts viz., (1) the retina which is formed as a pouch of the brain and (2) the lens which is derived from the skin of the side of the head. We know from various experiments that the retina of the tadpole, if cut off from the brain and pushed backwards under the skin to the region of the shoulder, will compel the skin in that region to form a lens—so that the development of a lens is dependent on the presence of a vigorous rudiment of the retina. But now we learn from Guyer's experiments that in the absence of a well-formed lens the retina cannot develop properly. for these rabbits with imperfect lenses had also reduced retinas so that the whole eye-ball was a vestigial object.

The important point in Guyer's experiments was that it was found that this vestigial eye was inherited through six generations without any further addition of the lens-destroying serum and that the effect instead of decreasing seemed rather to increase as the generations succeeded one another.

The inheritance was in most cases transmitted through the female line, but in two cases Guyer traced it through the male line; that is to say that when a male rabbit with imperfect eyes was crossed with a normal female some of the offspring showed imperfect eyes.

Now what explanation can be given of these extraordinary facts? We may, it seems to me, adopt one of three alternative hypotheses. (1) The serum of the fowls' blood has acquired a "cytolysin" which attacks the lens: this cytolysin introduced into the blood of the young rabbit destroys the lens. We may suppose that when this rabbit has young the cytolysin diffuses through the placenta and enters the blood of the young one in the womb. If we take this view we should believe that there is no true inheritance but only a mechanical transfer of serum.

We may again assume (2) that the lens owes its formation to a peculiar substance exuded from the retina of the developing eye, and that a similar substance exists in the egg. The cytolysin when introduced into the serum of the young destroys not only the lens-forming substance in the retina but also that in the egg so that the germ cells are permanently altered and only give rise to rabbits with imperfect lenses,—or lastly (3) we may suppose that the defective lens emits some substance which alters the egg in such a way that it tends to give rise to a rabbit with a defective lens in turn.

The first supposition is entirely disproved by the fact that these lens defects can be transmitted in the male line. A male with defective eyes when mated with a perfectly healthy female gave rise to offspring which all seemed to have perfectly normal eyes but if one of his daughters by this cross were mated with him, rabbits with imperfect lenses were produced. A defect introduced by the spermatozoon cannot be explained as being due to the mechanical transference of serum.

The second suggestion, viz., that the cytolysin acted at one and the same time on the lens of the embryo-rabbit and on the corresponding elements in its germ cells, is one that can always be made whenever proof is brought that acquired characters have been transmitted. It

will be noticed that in order to obtain a rabbit with defective lenses through the male line it is necessary that the mother though apparently normal in her eye-structure should be the offspring of a defective eyed male. This might be interpreted as meaning that the defective lens was recessive when a rabbit carrying it was crossed with a normal rabbit, and hence that the rabbit with defective eyes owed its origin to a defective germ cell. But the great difficulty in supposing that the original injection of serum acted on the germ cells of the rabbit whose eyes were affected, lies in the fact that none of the other germ cells of the rabbit which received the injection showed any trace of defect. When this rabbit had brought forth the young which she had in her womb at the time of the experiment she never transmitted to any subsequent litter any trace of eye defect. If the serum influenced the germ-cells of the embryos even though it had to penetrate the placenta in order to do so, why was it powerless to influence the germ-cells of the mother which were not protected from it by any barrier whatsoever?

In view of these facts, it seems impossible to evade the conclusion that the defective lens is the source of the influence which alters the potentiality of the germ-cell, or that acquired characters are transmitted.

It may be urged that such an accident of the environment as the invasion of the blood by the foreign serum is an occurrence very unlike any which we might expect to meet with in the ordinary course of nature.

This is undoubtedly true but the diminution of the lens through lack of the stimulus of light is an event which must have happened in the case of all cave-animals and deep-sea fishes—and if the lens is in equilibrium with a corresponding element in the germ cell, then diminution caused by the absence of light might be expected to act in the same way, though much more slowly than diminution caused by a cytolysin.

As a basis then for our discussion of eugenic theory and practice we shall assume that the alterations of structure due to the use and disuse of certain organs slowly affect the germ-cells, so that the offspring respond more quickly to these influences than did the parents and eventually become able to give rise to the altered organs before the stimuli which affected their parents have had time to act. I shall not here touch on the light which these principles throw on the evolutionary process, although that is a fascinating subject to the biologist. I wish to consider them in relation to the theory and practice of this Society.

Now the Eugenics Education Society differs from other societies which aim at Social Amelioration in the importance which it attaches to inborn characters. If the eugenic view is well founded the condition of the poor cannot be permanently improved by a policy of doles or even by a policy of free meals and education at the public expense. Their poverty, we assume, is fundamentally due to their inborn incompetence—intellectual and moral; and poverty can only be done away with by checking the reproduction of the incompetent and filling their places with the competent. It has been pointed out that in

Bethnal Green 100 years ago, there was neither Free education nor proper sanitation, whilst to-day both are provided—yet the death rate and the incidence of disease remain much the same as they were a century ago. One of our own members (Mr. Lidbetter) by the examination of parochial records has discovered that the same families in the London area generation after generation give rise to paupers and criminals.

If however external conditions affect the germ cells might not we hope in course of time slowly to improve the stock?

Now first of all let it be noted that the action of these conditions is an extremely slow one. The horse, as all know is a one-toed animal which has been evolved from a three-toed one. Three toed horses ranged over the Miocene plains at a period which must have been at least twenty million years ago—or to take a less extreme case—the world is now inhabited by very distinct races of men—yet to judge from the paintings executed at the time of the old Egyptian Kingdom four thousand years ago the races of men were as distinct then as they are now.

Now the Eugenic Education Society may—and we hope will succeed in stirring up a lively interest in the minds of men in the constitutions and fate of their children: they may even become interested in the character of their grand children, but it is to be feared that their emotions will be but faintly stirred by the probable type of their great grandchildren. In a word mankind will only be interested in eugenic reform in so far as it promises results within three or four generations. And such a period is too short to allow changes in external conditions to produce a noticeable effect on heredity.

Further, the effect of external conditions on the germ is only produced when the animal adopts new habits—that is accustoms itself to new activities. Evolution is not brought about by making things easier, but by making them more difficult,—if by evolution we mean advance in structure and increased activity. Of course for the biologist evolution means degeneracy as well as advance, but the social reformer does not seek to promote degeneracy.

Education should mean exercise of the mind; the call on it to use its powers. This is in fact the whole secret of classical education, now considered out-of-date by our upstart and loud-voiced demagogues—but which has had a good deal to do with the evolution of that splendid type of Englishman who in the past built up the Empire which we now enjoy. It is much to be feared that the mere acquisition of information which makes up too much of modern education, is not a process fitted to develop the mental powers nor one which may be expected to leave the slightest impress on the structure of the germ.

Still another point may be emphasised. So far as Kammerer's experiments go—modification of the germ in relation to changed conditions if it is to affect the race must be accompanied by a rigorous selection. Only the most vigorous individuals are capable of adaptation—the less vigorous succumb and die. When the Alytes toad pairs in water and lays its eggs therein only a few of these eggs hatch—and only healthy and well fed Salamanders will change their skin colours in accordance with the colours of their surroundings.

It is a very curious thing and one which may have a similar significance that no certain traces of evolutionary advance can be detected amongst civilised races; it is curious too that every civilized state known to history seems to have owed its stability to the organising power of a ruling caste who entered it as barbarian conquerors and to have fallen into decay when this ruling class died out. The multiplication of the relatively unfit, seems to have spelt the death-knell of every civilization.

Surely the lesson for the social reformer to be drawn from the consideration of facts like these is that at all costs the poor, defective, and incompetent should be prevented from breeding and the worst possible measure to be adopted is to encourage them to breed by throwing the cost of providing for their children on the more competent members of the community—a course of action which is loudly advocated and even partially adopted in England to-day.

The dregs of society do not consist of a special race but rather of intellectually and morally weak members,—of the type which may be designated as the "Mendelian recessive." The most interesting discovery which has been made by the followers of Mendel is that dominant and recessive allelomorphs are distinguished from one another by the presence in the dominant of some quality which is absent in the recessive. The recessives therefore are variants from the type in the direction of degeneration. What is the cause of their first appearance we do not know—all we do know is that wherever animals or plants are kept in large numbers these recessives make their appearance: in wild species and in savage states of human society they are ruthlessly eliminated.

But in addition to the ever present problem of the Mendelian recessive, there is the additional problem of the co-existence of races which are in very different stages of evolution. The Tasmanians recently extinct were simply unmodified survivors of Paleolithic man, the Hanùtic races in Africa represent the lowest stages in Neolithic culture. Now as mankind increases in numbers and spreads, one race tends to displace another and this process leads to prolonged and embittered conflicts. Consequently the question which arises and has become urgent in these latter days is whether this process can be arrested—in a word whether by education the more backward races can be "raised" to the level of the higher.

It must of course be admitted that a portion of what is called "culture" can be handed on from one race to another. Negroes can be drilled into being excellent soldiers: the Australian natives learn to read and write in the excellent schools provided by the Australian government: nay even a captive gorilla in the United States was taught by its owner (a lady) to live the life of a civilized human child—and died from a broken heart when it was removed from the care of its benefactress. The universal testimony however of all who have come into contact with these races is that they lack the moral qualities of the higher races and that it is impossible to confer these qualities on them by education.

To take the Iberian or Mediterranean Race for example. It is now found relatively pure in the South and West of Ireland, in Spain and

Portugal, in Southern Italy ("il mezzogiorno") and in Egypt. Everywhere it exhibits the same characteristics viz.:—a fiery temper quick to take offence and to revenge an insult real or fancied; an utter absence of scruple in the weapons chosen to attack an enemy, the secret dagger of the assasin being preferred to the open combat, a tendency to form secret societies and conspiracies, an utter disregard of truth and an incapacity for perseverance in work. In the same way it would be possible to diagnose the Negroes and the Malays.

Yet if we believe in evolution at all we must assume that all these races with their varied characters must have been evolved from one primitive human stock. It would be very interesting to discover under what circumstances this evolution took place. Now on this subject a great deal of light has been thrown by a brilliant Canadian palaeontologist (Matthews) in a paper entitled "Climate and Time." In this essay he points out that all the evidence points to the North as the region where this evolution took place. Swarm after swarm passing out from this breeding place spread south and overran lands where life was easier and food more abundant, so that the most primitive surviving races of man did not originate where they are now found since their present abode represents their last refuge from the incursions of the higher races. The Bushmen, now one of the lowest races found on the globe, are represented to-day only by a few dwindling hordes which wander over the Kalahari desert of South Africa. Yet we have evidence that three or four hundred years ago they inhabited all Africa south of the Equator—whilst from paintings on the walls of caves in France dating from Mid-Glacial time we infer that at that date Bushmen inhabited Europe.

The dominant race of Europe, the tall fair-haired blue-eyed people who have created European history and founded all the ruling dynasties of Europe, seem to have been the latest product of the progressive evolution of mankind. Though now found with least admixture in the Scandinavian peninsula they cannot have originated there for this peninsula 7000 years ago was covered with a continuous ice sheet. Their original home seems to have been round the shores of the Baltic and of the North Sea: perhaps as Sir Arthur Keith has suggested they inhabited that land which in quite recent geological times stretched from the Humber to Jutland across what is now the Flemish bight. The climate was cold—but not in all probability, Arctic, it rather resembled the Norwegian climate of to-day. The source of livelihood of the race was found in the shoals of fish which inhabited the shallow waters of the neighbouring sea. Under these circumstances a breed of fearless sea-rovers was evolved, of boundless enterprise, intrepid bravery and faithful adherence to their leaders—without which no successful voyage could have been undertaken. The cool invigorating climate with its cold winters led to a postponement of the age of sexual maturity, and hence to great growth in stature and muscular development, for these things are in the inverse ratio to sexual precocity.

If the qualities of our race were developed under circumstances such as these—through a history extending over thousands of years in the course of a terrific conflict with Nature is it reasonable to suppose

that in one or two generations of free parliaments and free popular education these qualities be grafted on to a totally different race with a different history from our own, and with a totally different complex of acquired mental qualities? To this question the history of Liberia, of the negro republics of Hayti and S. Domingo, and even of the South American Portuguese and Spanish Republics afford a sufficient reply. To make a negro into a white man, a section of the negro race ought to be isolated in a cold sunless climate where only by the most intrepid exertions could food be obtained If any of the race survived (for undoubtedly the vast majority would perish) we might expect to find in the course of half a million years an independent evolution in the direction of the formation of a new white race.

If the conclusions which I have endeavoured to draw from the evidence which I have laid before you are sound, we must view with grave misgiving the policy which the United States have pursued in the past of opening their doors to immigrants of all races. To call the resulting mixture Anglo-Saxon is a serious misuse of words—especially when we learn that the Iberian races with their lower standards of comfort are multiplying at a rate far in excess of that shown by the population of British ancestry. Anglo-Saxon traditions still prevail but it is hopeless to expect them to survive once the racial composition of the population is radically altered.

The policy of Australia in excluding oriental races and still more that of New Zealand in restricting the right of entry to immigrants of British Birth is eugenically far more sound.

We become convinced of the soundness of the policy repeatedly advocated in our Society of Eugenic selection as the only means by which racial improvement can be effected in a relatively short time. "A fair field and no favour"—so long the motto of our race—now too often forgotten in these days of maudlin sentimentality—is the only rule which can guide us to real progress. It is however a new encouragement to learn that the effects of effort are not lost but are in some degree inherited by the next generation and that education when it becomes too easy is no education at all.